

Civil Air Patrol
Aerospace
Mini - Book
of
Logic
and
Puzzles



For
Upper Elementary And
Middle School Students

SCIENCE AND MATH STANDARDS — The activities in this mini-booklet are designed to help students develop critical thinking skills. In preparing students for the 21st century, five basic skills areas have consistently been identified as essential:

creative thinking
 problem solving and decision making
 reasoning and critical thinking
 effective communication
 cooperative group work

These activities are designed to help develop and implement strategies that utilize these essential skills so that they can be applied to all areas of learning.

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Aerospace education is that branch of general education concerned with communicating knowledge, skills, and attitudes about aerospace activities and the total impact of air and space vehicles upon society.

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Solar System Math

- I. On the average, Neptune is approximately 2,800 million miles from the sun. If an airplane flies at 1,400 miles per hour, how many years would it take to fly from Neptune to the Sun?

- II. What is your age on Earth? _____
Mercury circles the Sun once every _____ Earth days.
Convert your Earth age to your age in Mercury years _____
HINT: A Mercury year equals one circle of Mercury around the Sun.

- III. Compare the diameter of Saturn's largest moon with the four Galilean satellites of Jupiter.

Galilean satellite Io

Galilean satellite Europa

Galilean satellite Ganymede

Galilean satellite Callisto

Saturn's largest moon, _____, has a diameter of
_____ miles.

IV. **FOR EXTRA CREDIT:**

List two sources in which you can find Mercury's orbit time around the Sun. **OR**
List two sources in which you can find the diameter of Jupiter's four Galilean moons.

Flying High!

I If a jet travels 300 miles per hour, how many feet per second will it travel?

II.

M I L E A G E B E T W E E N C I T I E S						
Philadelphia Pennsylvania	Memphis Tennessee	Dallas Texas	Phoenix Arizona	Los Angeles California	Denver Colorado	Philadelphia Pennsylvania
[start]	989	455	2,045	389	1,009	1,762

[To use the chart: Start at Philadelphia. The distance to the first stop [Memphis] is 989 miles. The distance between Memphis and Dallas is 455 miles; between Dallas and Phoenix, 2,045 miles, and so on until you return to Philadelphia from Denver.]

If you flew a route that took you from Philadelphia to Memphis, Dallas, Phoenix, Los Angeles, Denver, and back to Philadelphia, how far would you have traveled?

If your jet flew at 300 miles per hour, how long would it take you to fly between each of the cities? (Round your answer to the nearest tenth.)

If you allowed an additional fifteen minutes for each takeoff and fifteen minutes for each landing, how much time would your complete flight plan require?

Your plane uses an average of 25 gallons of fuel per hour of flying time (including the takeoffs and landings). How many gallons of fuel will you need to complete your trip?

If your fuel costs \$2.25 per gallon, how much will the fuel cost?

III. The Wright *Flyer* was the first heavier-than-air powered craft to fly successfully. It flew for 12 seconds, covering 120 feet. The *Flyer* was 21 feet, 1 inch long, weighed 746 pounds, and had a wing span of 40 feet, 4 inches. The SR-71 *Blackbird* was a high-altitude, high-speed military reconnaissance plane. It set a world speed record in 1976, flying 2,193.7 miles per hour in a straight line at 85,00 feet. The SR-71 was 107 feet, 4 inches long, weighed 67,550 pounds (without fuel), and had a wing span of 55 feet 6 inches. Compare the length, weight, and wing span of the two planes.

Example: The wing span of the Wright Flyer is _____ more / less than the SR-71 or
The wing span of the Wright Flyer is _____ % of the wing span of the SR-71.

If the SR-71 flew 15,000 miles in ten and one-half hours, what would be its average airspeed (in miles per hour)?

A SR-71 surveyed 723,042.6 square miles of the nation in one hour.

How many square miles are there in the United States? _____

How much of the United States did the plane's flight cover? _____

For the Instructor:

Solar System Math:

I. To calculate the years to travel from Neptune to the Sun:

Calculate the number of hours per year (365 days X 24 hours per day) = 8,760

Calculate the number of miles per year (1,400 miles per hour X number of hours per year)
12,264,000

Solve for the total number of years (2,800,000,000 miles divided by number of miles per year)
228.3105023 years

II. To calculate your age in Mercury years:

Divide 88 days (one Mercury year) into 365 days (one Earth year) = 4.15. Multiply your answer [4.15] by your age in whole Earth years to determine the age in equivalent Mercury years.

CHALLENGE: Calculate your age in whole and partial years on Mercury:

Multiply the years of your Earth age by 365.

Multiply the number of months since your last birthday by 30. Add to your first answer.

Add the number of days since the date of your birthday. Add to your answer.

Multiply your answer by 4.15 (the ratio of Mercury years to one Earth year).

III. The Galilean satellites of Jupiter are the planet's four largest moons. They were discovered by Galileo in 1610 and were named by the German astronomer Marius. To compare the diameters of the Galilean satellites with the diameter of Titan (the largest moon of Saturn):

Determine the diameters of Titan
and the four Galilean satellites:

To compare, subtract the diameter of each
Galilean satellite from the diameter of Titan.

Satellite	Diameter	Difference
Titan	3,201 miles	
Io	2,256 miles	945 miles
Europa	1,950 miles	1,251 miles
Ganymede	3,270 miles	- 69 miles
Callisto	2,983 miles	149 miles

Flying High!

- I. One mile equals 5,280 feet. Multiply by the 300 miles; this equals 1,584,000 feet in 300 miles.
One hour equals 3,600 seconds (60 minutes per hour times 60 seconds per minute).
Divide 1,584,000 by 3,600 to get 44 feet per second.

Miles	Time [miles ÷ 300 mph]	Rounded Time
989	2.296 hours	2.3 hours
455	1.516 hours	1.5 hours
2,045	6.816 hours	6.8 hours
389	1.296 hours	1.3 hours
1,009	3.363 hours	3.4 hours
1,762	5.873 hours	5.9 hours
6,649	[Totals]	21.2 hours

Add the mileage legs together: 6,649 total miles.
Add rounded hours: 21.2 hours.
Multiply 15 minutes X 12 for takeoff / landing times. Divide by 60 to reduce to hours.
Add the 3 hours to the trip hours.
Total time: 24.2 hours

Fuel: 25 X 24.2 = 605 gallons
605 gallons X \$2.25 = \$1,361.25

III. To compare measurements, subtract the Wright Flyer measurements from the SR-71 measurements: The SR-71 is 86 feet 3 inches longer, weighs 66,704 more pounds, and has a wing span 15 feet 2 inches larger than the Wright Flyer.

To find the average airspeed per hour, divide 15,000 miles by 10.5 hours; the average airspeed is 1,428.57 miles per hour.

The United States covers 3,615,213 square miles. If the SR-71 surveyed an area measuring 723,042.6 miles, that would be an area equal to two-tenths of the total square mileage of the nation.

YOUR PLACE IN SPACE

Create a diagram to show where you fit in the universe. (Start at the top of the triangle.)
Begin with yourself and use the following:

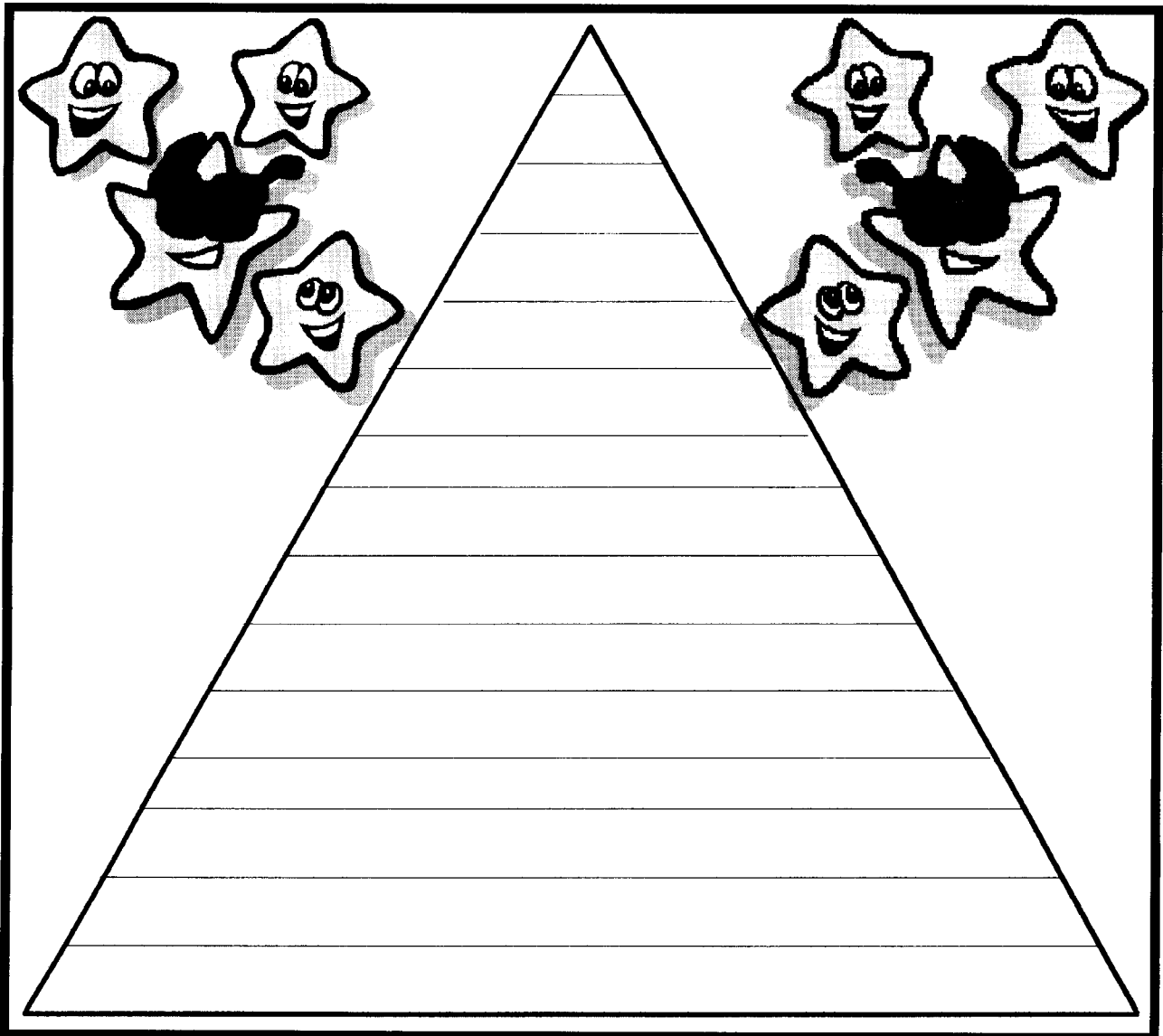
continent
country
county
galaxy

hemisphere
home
local group
planet

solar system
state
street
super cluster

town
yourself
universe

VARIATION: List the above in logical order; indicate the information to create your address.
Which parts of your address are unique?
Which are the same as other students in your class?
Which are the same for all people on Earth?



Logic / Problem Solving

For the Instructor

The flow chart or diagram should progress as follows:

Yourself	[Name]	-----	[Unique to each student]
Home	[House number]	-----	[May be unique to each student]
Street	[Street name]	=====	
Town	[Name of town]	=====	[Generally the same for all students]
County	[Name of county]		
State	[Name of state]		
Country	[Name of country]		
Continent	[Name of continent]		
Hemisphere	[Name of hemisphere]	=====	
Planet	[Earth]	=====	[The same for all people of Earth]
Solar System			
Galaxy	[Milky Way]		
Local Group			
Super Cluster			
Universe			

★ ★ ★ ★ ★ ★ ★ ★

Spaceworks and Soaring Aloft

[see the following two pages]:

Spaceworks solution:

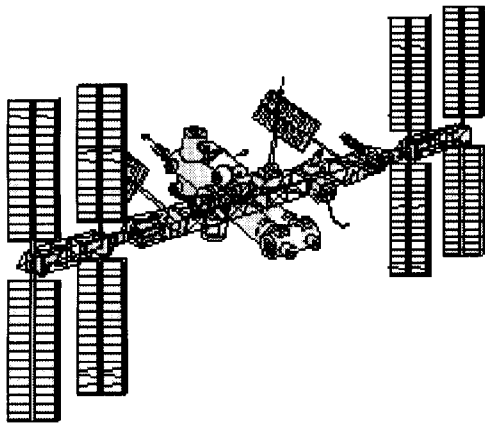
ASTRONAUT	SPECIALTY	DURATION OF STAY
Althea	computer expert	staying permanently
Chris	astrobotanist	one year or more
Elizabeth	maintenance systems specialist	three months or less

Spaceworks Aloft solution:

PILOT	AIRCRAFT	DURATION OF FLIGHT
Allen	airplane	several hours
Connie	helicopter	an hour or less
Edwin	glider	unknown

SPACEWORKS

Three astronauts have been assigned to a tour of duty on the International Space Station. One is an astrobotanist, one is a computer expert, and the third is a maintenance systems specialist. Each is assigned a specific task required to keep the space station running smoothly. Use the clues to discover each astronaut's field of expertise and how long they expect to stay on the space station.



1. Neither Althea nor Elizabeth likes plants.
2. The astronaut who likes to work with computers also plans to stay on the space station.
3. Elizabeth plans to begin a new NASA training course at Johnson Space Center, Texas in three months.
4. The astronaut who likes plants will develop and carry out a new annual crop rotation plan.

ASTRONAUT	SPECIALTY	DURATION OF STAY
Althea		
Chris		
Elizabeth		

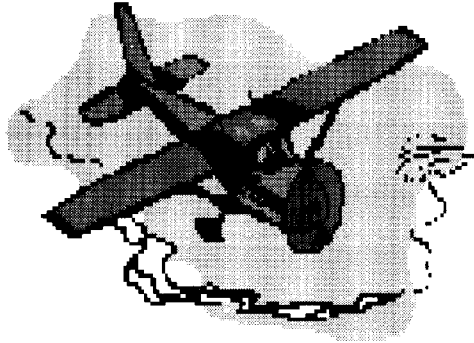
Choose each astronaut's specialty and duration of stay from the following two lists:

Specialty: astrobiologist
 astrobotanist
 computer expert
 maintenance systems specialist

Duration of Stay: one year or more
 staying permanently
 three months or less
 three years

SOARING Aloft

At eight o'clock this morning, three pilots headed out to do some recreational flying. Each of the pilots was flying in a different type of craft: one in an airplane, one in a glider, and the third in a helicopter. Use the clues to discover each pilot's craft as well as how long they expected their flight to last.



1. Edwin does not like loud noises.
2. The pilot who is flying the airplane will travel to another city for a meeting in the afternoon.
3. Connie has an appointment across town at nine o'clock this morning.
4. The pilot who flies with the thermals has no plans for the afternoon.

PILOT	TYPE OF AIR CRAFT	DURATION OF FLIGHT
Allen		
Connie		
Edwin		

Select each pilot's type of air craft and duration of the following two lists:

Type of Air Craft: airplane
balloon
glider
helicopter

Duration of Flight: an hour or less
one day
several hours
unknown

It's All In The Name

Directions:

This is a space environment research exercise. Work with a partner to find names which start with letters at the top of the grid and are constellations, stars, planets, moons, or asteroids.

EXTRA EFFORT — Discuss facts about each of these elements of the space environment or draw pictorial representations of your answers.



M

P

S

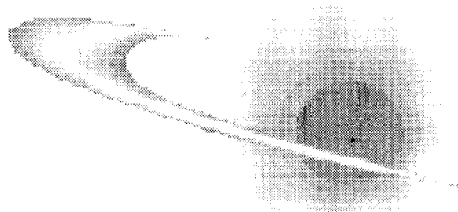
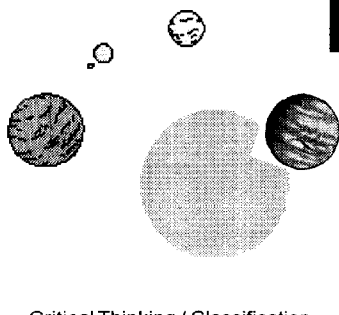
Constellations

Stars

Planets

Moons

Asteroids



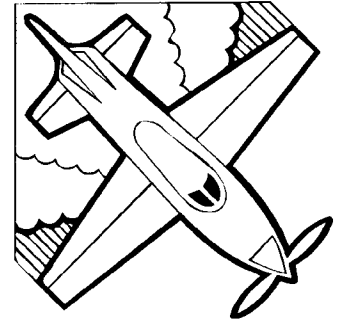
Critical Thinking / Classification

WHAT'S My NAME?

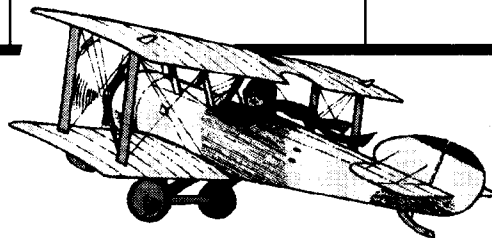
Directions:

This is a famous personalities in aviation exercise. Work with a partner to find aviation names to complete the grid. Remember, the name must fit in the category listed in the far left column and must begin with the letter shown at the top of the column.

EXTRA EFFORT — Give a brief presentation on one aviation personality and their special accomplishments.



	B	C	S
Aviation Pioneers			
Balloonists			
General and Business Aviation Aircraft Models			
Vertical Flight Pioneers			



For the Instructor:

There are several correct answers for each category in these two exercises. In helping students develop logical thinking skills, the process used to complete the exercise is often more important than the actual answer.

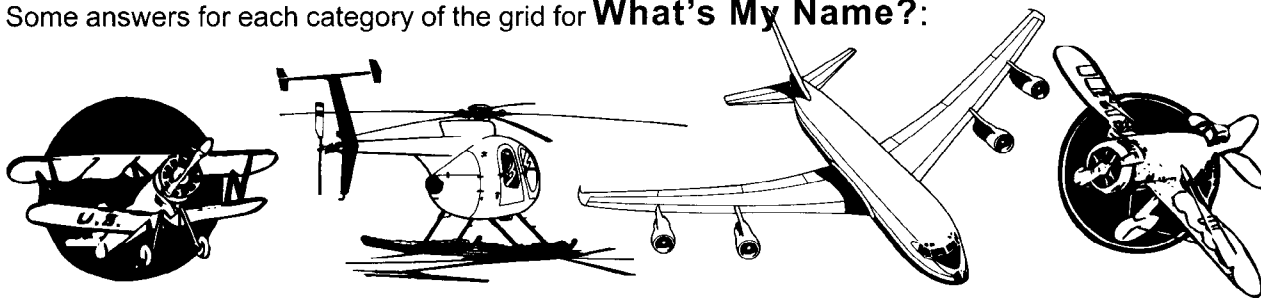
Depending on the class and on the objective of the lesson, students can research to find a correct name for each box in the grid or a list may be supplied from which the students can choose answers for the grid. The directions call for students to work with a partner; students may also work alone or in larger groups. Remember, the process is the focus of these exercises.

Some answers for each category of the grid for **It's All In The Name:**

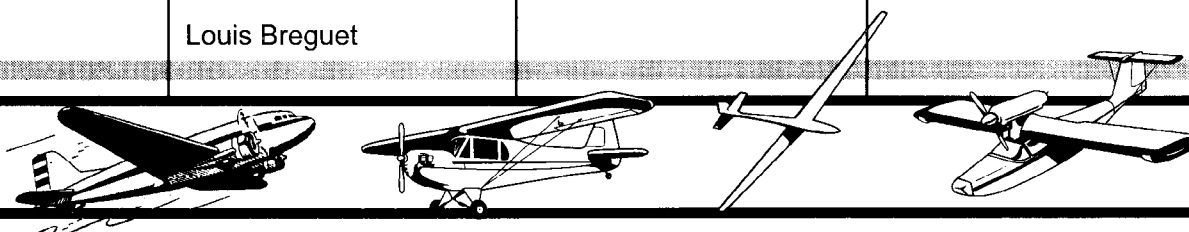
	M		P		S	
Constellations	Mensa Microscopium Monoceros Musca		Pavo Pegasus Piscis Austrinus Pictor Pisces	Perseus Phoenix Puppis Pyxis	Sagitta Sagittarius Scorpius Sculptor	Scutum Serpens Sextans
Stars	Markab Megrez Mintaka Mira	Mirach	Proxima Centauri Pollux Polaris		Sceptrum Sigma Octantis Sirius Sirius B	Spica SS433 The Sun
Planets	Mercury Mars		Pluto		Saturn	
Moons	Moon Mimas Miranda		Pandora Pasiphae Phobos Phoebe	Portia Puck	Sinope	
Asteroids	Melpomene [Asteroid 18] Metis [Asteroid 9] Midas [Asteroid 19981]		Pallas [Asteroid 2] Parthenope [Asteroid 11] Patientia [Asteroid 451] Patroclus [Asteroid 617] Phaethon [Asteroid 3200] Priamus [Asteroid 884]		Sisyphus [Asteroid 1866]	



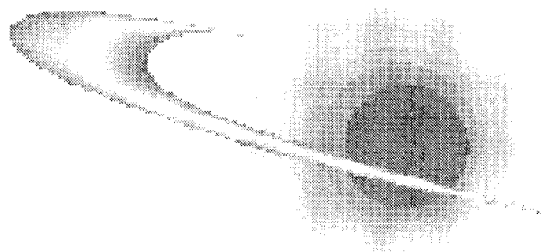
Some answers for each category of the grid for **What's My Name?:**



	B	C	S
Aviation Pioneers	Louis Bleirot	Sir George Cayley Octave Chanute Jacqueline Cochran A. Scott Crossfield Glenn Curtiss	Alberto Santos-Dumont Thomas Selfridge John Stringfellow
Balloonists	Pierre Blanchard	Tiberius Cavallo Henry Cavendish J. A. C. Charles Ron Clark Henry Coxwell	David Simmons
General and Business Aviation Air- craft Models	Beechjet [Beech] Bonanza [Beechcraft]	Cadet [Piper] Centurion [Cessna] Chaparral [Mooney] Cherokee Arrow [Piper] Cherokee Cruiser [Piper] Cheyenne III [Piper] Cheyenne III A [Piper] Citation [Cessna] Cutlass [Cessna]	Sierra [Beechcraft] Skipper [Beechcraft] Skyhawk [Cessna] Skymaster [Cessna] Skysedan [Piper] Skywagon [Cessna] Starship [Beechcraft] Sundowner [Beechcraft] Super Cub [Piper] Super King Air [Beechcraft]
Vertical Flight Pioneers	Emile Berliner Henry Berliner Louis Breguet	Paul Cornu	Igor Sikorsky



STELLER CALCULATIONS

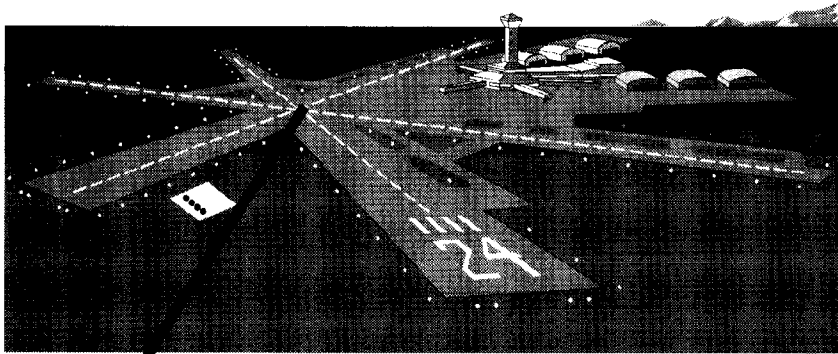


Starting at the planet, move through the grid, going alternately from a number to an operations sign. Move in any direction, being certain to follow the pattern. Find a pathway that will give you the correct answer as shown on the star. How many different pathways can you find?

7	+	2	+	8	X	1	÷
X	4	÷	0	÷	1	+	6
4	X	2	+	3	-	4	-
-	1	X	5	÷	2	+	8
6	-	8	+	4	X	1	+
+	5	-	1	-	3	÷	2
2	+	4	X	7	-	1	X
X	7	÷	5	+	0	-	4

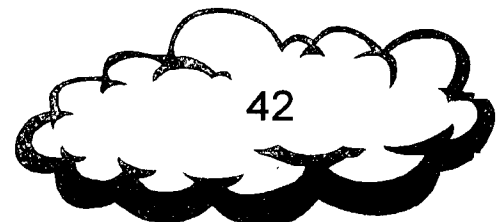


AERODYNAMIC CALCULATIONS



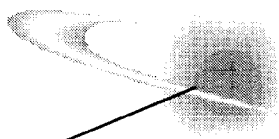
Starting at the airport, travel through the grid, going alternately from a number to an operations sign. Move in any direction, being certain to follow the pattern. Find a pathway that will give you the correct answer as shown on the cloud. How many different pathways can you find?

4	-	0	+	5	÷	7	X
X	1	-	7	X	4	+	2
2	÷	3	-	1	-	5	+
+	1	X	4	+	8	-	6
8	+	2	÷	5	X	1	-
-	4	-	3	+	2	X	4
6	+	1	÷	9	÷	3	X
÷	1	X	5	+	2	-	5



For the Instructor:

There are several solutions for either grid. Here is one solution for each puzzle:



7	+	2	+	8	X	1	÷
X	4	÷	0	÷	1	+	6
4	X	2	+	3	-	4	-
-	1	X	5	÷	2	+	8
6	-	8	+	4	X	1	+
+	5	-	1	-	3	÷	2
2	+	4	X	7	-	1	X
X	7	÷	5	+	0	1	4

24



4	-	0	+	5	÷	7	X
X	1	-	7	X	4	+	2
2	÷	3	-	1	-	5	+
+	1	X	4	+	8	-	6
8	+	2	÷	5	X	1	-
-	4	-	3	+	2	X	4
6	+	1	÷	9	÷	3	X
÷	1	X	5	+	2	-	5

42

And The Question Is and Questions, Please

[see the following two pages]

Answers for each section will vary.

Discuss the students' questions in each category.

And The Question Is

Work with a partner. What questions can you ask for each answer?

Example: Answer: **Books**

Questions:

- A. What might you find in a special store?
- B. What can you use to help you find information?
- C. What can usually be found in any classroom?
- D. What can be used to help tell a story?

Answer: **Constellations**

- A.
- B.
- C.
- D.

Answer: **Black hole**

- A.
- B.
- C.
- D.

Answer: **Astronauts**

- A.
- B.
- C.
- D.

QUESTIONS, PLEASE

Work with a partner. What questions can you ask for each answer?

Example: Answer: **Cereal**

Questions:

- A. What might you eat for breakfast?
- B. What is a food that can be served hot or cold?
- C. What usually comes in a cardboard box?
- D. What is a type of food that is not usually found in a garden?

Answer: **Airport control tower**

- A.
- B.
- C.
- D.

Answer: **Aircraft control surfaces**

- A.
- B.
- C.
- D.

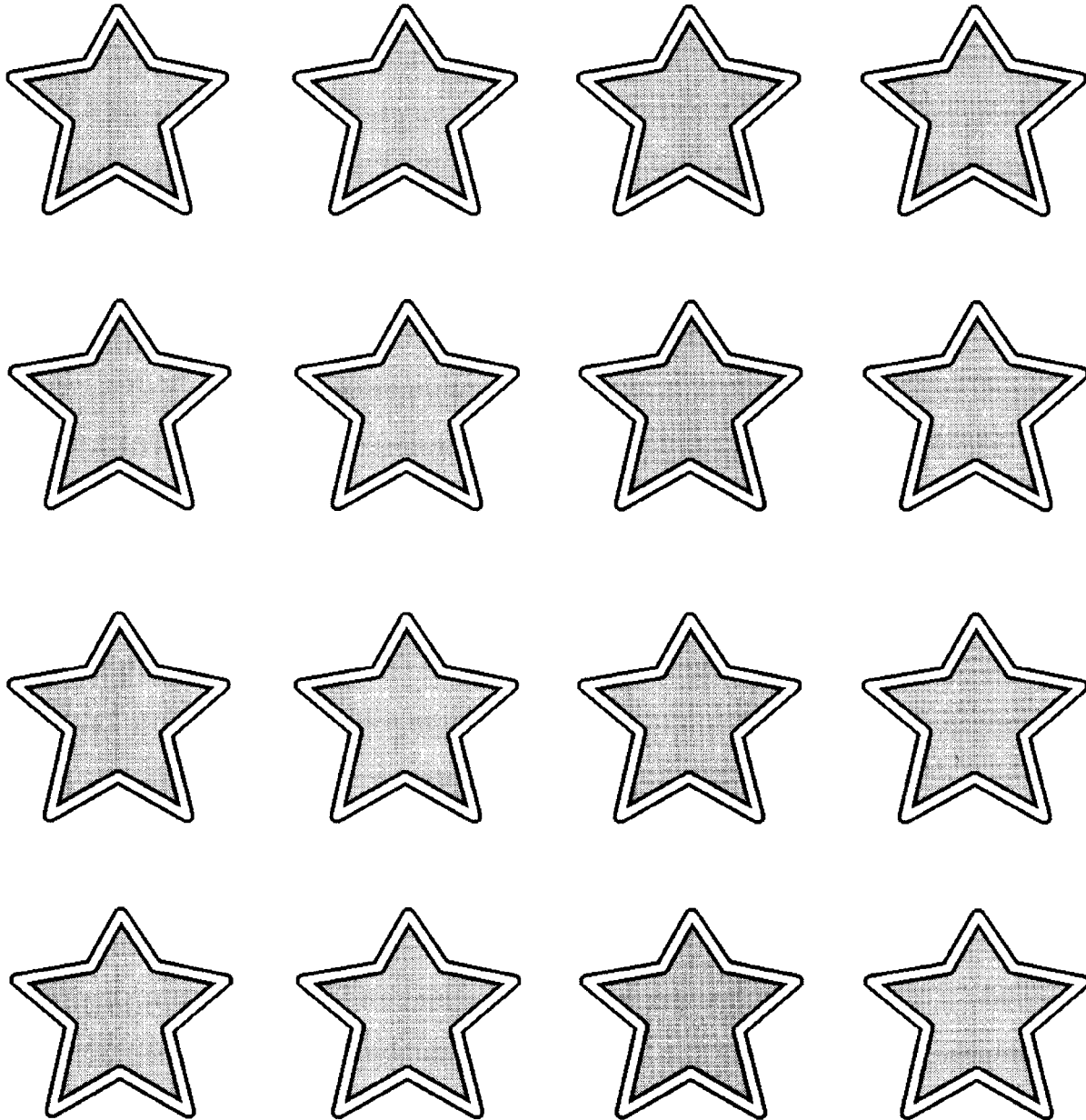
Answer: **Pilots**

- A.
- B.
- C.
- D.

Brainstorming / Flexible Thinking

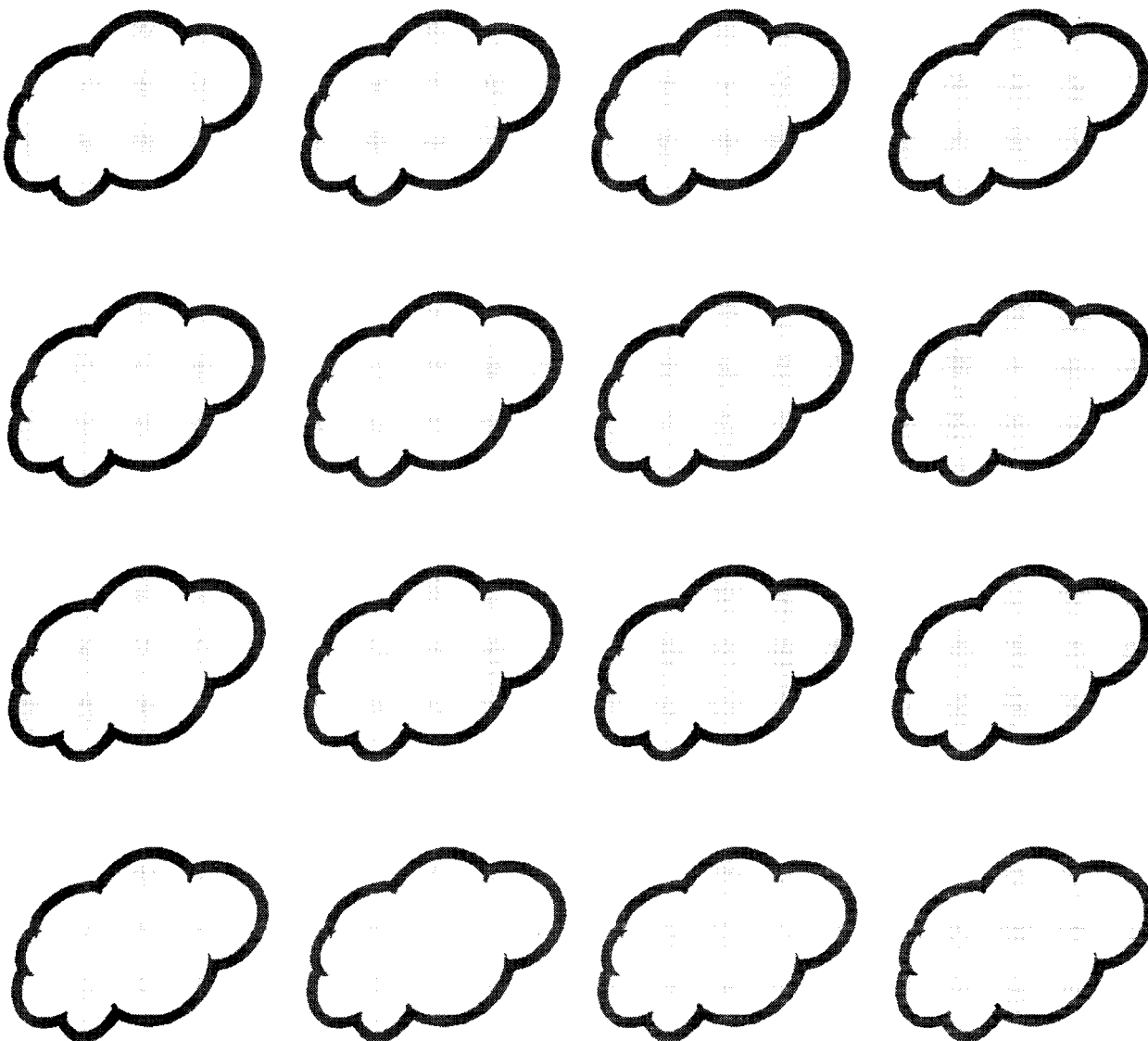
NUMBER THE STARS

Using numerals 1 through 16, number the stars. Numbers in sequence cannot be placed next to each other in any direction.



NUMBER THE CLOUDS

Using numerals 1 through 16, number the clouds. Numbers in sequence cannot be placed next to each other in any direction.



For the Instructor:

There are several possible placements of the numerals in the stars or the clouds. Two solutions are shown below.

3 5 1 13

7 1 14 10

12 16 11 6

15 11 4 12

8 4 9 15

6 9 16 8

10 14 2 7

13 2 5 3

Galatic Places and Tower Control

[see the following two pages]

There are several solutions for filling the grid. Below is one solution for each of the grids.

GALATIC PLACES

sun	rocket	star	planet
planet	star	rocket	sun
rocket	sun	planet	star
star	planet	sun	rocket

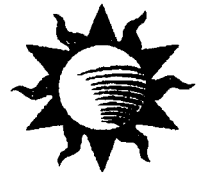
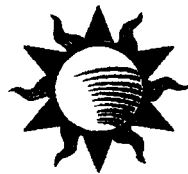
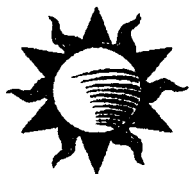
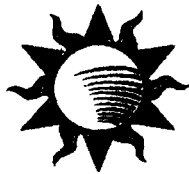
TOWER CONTROL

plane	balloon	cloud	helicopter
helicopter	cloud	balloon	plane
balloon	plane	helicopter	cloud
cloud	helicopter	plane	balloon

GALACTIC PLACES

Place all the objects in the squares.

Each row, column, or four-box diagonal may contain only one of each object.

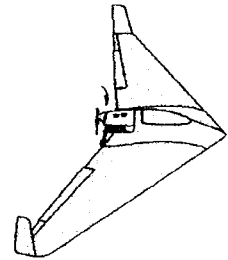
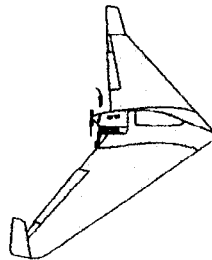
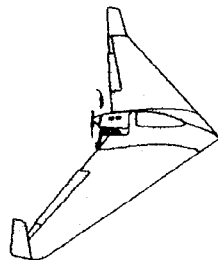
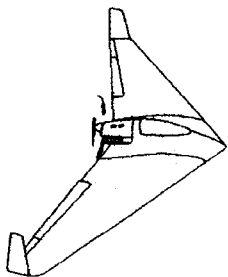
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Logic / Problem Solving

TOWER CONTROL

Place all the objects in the squares.

Each row, column, or four-box diagonal may contain only one of each object.





AEROSPACE EDUCATION

SERVING

★ CADETS ★ TEACHERS ★ CHILDREN
★ SENIOR MEMBERS ★ CITIZENS OF AMERICA

